

AMENDMENTS TO THE CLAIMS

1 (Original) A method of operating a pixel, the method comprising:

transferring charge, accumulated in a photoactive region of the pixel during a first period, through a second active region of the pixel to a power supply node; and

transferring charge, accumulated in the photoactive region during a second period, through the second active region to a sense node in the pixel.

2 (Original) The method of claim 1 including:

setting an amount of charge in the second active region at substantially a predetermined level prior to transferring the charge accumulated during the first period.

3 (Original) The method of claim 2 including:

resetting the amount of charge in the second active region at substantially the predetermined level prior to transferring the charge accumulated during the second period.

4 (Original) The method of claim 3 including:

reading out a pixel signal level corresponding to the charge previously transferred to the sense node;

resetting the sense node;

resetting the amount of charge in the second active region substantially at the predetermined level;

subsequently transferring charge from the second active region to the sense node; and

reading out a pixel reset level corresponding to the charge most recently transferred to the sense node.

5. (Original) The method of claim 4 including:
obtaining a differential signal based on the pixel signal level and the pixel reset level.

6. (Original) The method of claim 3 wherein setting and resetting the amount of charge in the second active region include flooding the second active region with charge and subsequently transferring charge from the second active region to the power supply node.

7. (Original) A method of operating an image sensor comprising an array of pixels, the method comprising:

transferring, for each pixel, charge accumulated during a first period from a photoactive region of the pixel to a power supply node of the pixel through a second active region of the pixel;

allowing photocharge to accumulate in the photoactive region of each pixel during a second period; and

transferring the charge accumulated in the photoactive region of each pixel during the second period to a respective sense node in the pixel through the second active region of the pixel, wherein the latter transfer occurs substantially simultaneously for all the pixels.

8. (Original) The method of claim 7 including reading out pixel signal levels from the array of pixels one row of pixels at a time, wherein a pixel signal level corresponds to the charge previously transferred to a pixel's sense node.

9. (Currently Amended) The method of claim 8 including performing the following with respect to a particular row of pixels after reading out pixel signal levels from the particular row and prior to reading out pixel signal levels of a subsequent row of pixels:

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resetting the pixel's sense node;

resetting the amount of charge in the pixel's second active region substantially at the predetermined level;

subsequently transferring charge from the pixels second active region to the ~~pixels'~~pixel's sense node; and

reading out a pixel reset level corresponding to the charge most recently transferred to the ~~pixels'~~pixel's sense node.

10. (Original) The method of claim 7 including:

setting an amount of charge in the second active region of each pixel at substantially a respective predetermined level prior to transferring the charge accumulated during the first period; and

resetting the amount of charge in the second active region of each pixel at substantially the respective predetermined level prior to transferring the charge accumulated during the second period.

11. (Original) An image sensor comprising:

a plurality of pixels formed in a semiconductor substrate, wherein each pixel includes:

a photoactive region in the substrate; and

a second active region in the substrate separate from the photoactive region;

a sense node; and

a power supply node;

the image sensor further including a controller arranged to cause control signals to be provided to each pixel to cause the pixel to:

transfer charge accumulated, in the pixel's photoactive region during a first period, to the power supply node through the pixel's second active region; and

transfer charge, accumulated in the pixel's photoactive region during a second period, to the pixel's sense node through the pixel's second active region.

12. (Original) The image sensor of claim 11 wherein the controller is arranged to cause control signals to be provided to each pixel to cause the pixel to set an amount of charge in the pixel's second active region at substantially a predetermined level prior to transferring the charge accumulated during the first period.

13. (Original) The image sensor of claim 12 wherein the controller is arranged to cause control signals to be provided to each pixel to cause the pixel to reset the amount of charge in the pixel's second active region at substantially the predetermined level prior to transferring the charge accumulated during the second period.

14. (Original) The image sensor of claim 13 wherein the controller is arranged to cause control signals to be provided to each pixel to cause the pixel to:


read out a pixel signal level corresponding to the charge previously transferred to the pixel's sense node;

reset the pixel's sense node;

reset the amount of charge in the pixel's second active region substantially at the predetermined level;

subsequently transfer charge from the pixel's second active region to the pixel's sense node; and

read out a pixel reset level corresponding to the charge most recently transferred to the pixel's sense node.



15. (Original) The image sensor of claim 13 wherein the controller is arranged to provide the control signals to each pixel so that all the pixels transfer the charge accumulated in the their respective photoactive regions during the second period at substantially the same time.

16. (Original) An image sensor comprising:

a plurality of pixels formed in a semiconductor substrate, wherein each pixel includes:

a photoactive region in the substrate; and

a second active region in the substrate separate from the photoactive region;

a sense node; and

a power supply node;

the image sensor further including a controller arranged to cause control signals to be provided to each pixel so that the pixel can operate in any one of at least four modes including a first mode in which photocharge generated in the photoactive region is accumulated in the pixel's photoactive region; a second mode in which charge

is transferred from the pixel's photoactive region to the pixel's second active region; a third mode in which charge is transferred from the pixel's second active region to the pixel's power supply node; and a fourth mode in which charge is transferred from the pixel's second active region to the pixel's sense node.

17. (Currently Amended) The image sensor of claim ~~16~~16 ~~when~~wherein the controller is arranged to cause the control signals to be provided to each pixel so that charge accumulated in the pixel's photoactive region during a first period is transferred through the pixel's second active region to the pixel's power supply node without passing through the pixel's sense node, and so that charge accumulated in the pixel's photoactive region during a second period is transferred through the pixel's second active region to the pixel's sense node.

18. (Original) The image sensor of claim 17 wherein the controller is arranged to cause control signals to be provided to each pixel so that an amount of charge in the pixel's second active region is set substantially at a predetermined level prior to causing the transfer of charge accumulated during the first period from the pixel's photoactive region to the pixel's power supply node.

19. (Original) The image sensor of claim 18 wherein the controller is arranged to cause control signals to be provided to each pixel so that an amount of charge in the pixel's second active region is set substantially at the predetermined level prior to causing the transfer of charge accumulated during the second period from the pixel's photoactive region to the pixel's sense node.

20. (Currently Amended) The image sensor of claim 19 ~~when~~wherein each pixel includes a reset switch, and wherein the controller is arranged to enable the reset switch to reset the pixel after a pixel signal level is read out.

21. (Original) The image sensor of claim 20 wherein the controller is arranged to cause control signals to be provided to each pixel after the pixels are reset so that an amount of charge in each pixel's second active region is set substantially at the predetermined level, and subsequently to cause bias signals to be provided to transfer a pixel reset level from each pixel's second active region to the pixel's sense node.

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22. (Original) The image sensor of claim 16 wherein the pixels include active pixel sensors.

23. (Original) The image sensor of claim 16 wherein the pixels include photo-gate type active pixel sensors.

24. (Original) The image sensor of claim 16 wherein a photocharge integration period occurs for all the pixels in the sensor at the same time, and wherein charge accumulated in each pixel's photoactive region during the integration period is transferred to the pixel's sense node at the same time for each of the pixels.
